

REMARKS

Initially, the Examiner rejected the claims in this case as being unpatentable over McGlone '900, which is assigned to International Game Technology. In this rejection, the Examiner has rejected the claims over Stockdale '014, also assigned to International Game Technology. The only apparent difference in the rejections is that the Examiner has substituted the word Stockdale for McGlone. However, the Examiner's comments beginning at page 3, line 4 which begin "In a preferred embodiment . . ." and continuing down through line 14 which ends with the words "and a slot reel 420" is subject matter found only in the '900 patent.

In both the '014 and '900 patent, the authors who have assigned to International Game Technology use the terms "high-level instructions" and "low-level instructions". This description is found in '900, column 3, lines 45 - 61, at column 6, lines 44 - 55 where "low-level instructions" are described as those which might include turning on a specific light, turning off a specific light, starting a motor or stopping a motor. These are instructions not requiring a further use of an assembly language or further processing in order to create signals which can control the specific elements enumerated. '900 at column 9, lines 40 - 55 draws a clear distinction between high and low level instructions. The distinction here is that an additional slot reel controller (402) would be necessary in order to convert from high-level

instructions from the gaming controller to low-level slot instructions. This shows clearly that in the terminology of International Game Technology, low-level instructions are those not requiring further processing.

Referring now to the '014 patent, which is relied upon in the instant rejection, it can once again be seen that the authors distinguish between high-level and low-level instructions on the basis of whether or not the low-level instructions provide for precise control and operation of the peripheral devices (column 3, lines 35 - 38; column 3, lines 51 - 64; column 8, lines 45 - 55; column 14, lines 48 - 58; column 17, lines 17 - 55).

Claim 1

The principal point of Applicant's invention as set forth in claim 1 is that the lower control device (hardware) is provided separately from an intermediate control device, and that three (high, intermediate, and low) control devices are unified as a series. These three devices and their order of control is all set forth in the claim describing the control device, the main control device, the intermediate control device and the lower control device. By providing a lower control device, especially for controlling peripheral devices including image display devices, the gaming machine becomes faster than those using conventional communication means between only two control means, which are the main controller and subcontroller as disclosed in Stockdale '014.

Providing three control devices, including a third hierarchical level device (sub-subcontrol board) as a series makes it possible to divide and control programs hierarchically, and to execute processing more efficiently. This is especially important in the environment of gaming machines which have large requirements for software dedicated to peripheral functions and devices. The three kinds of hardware provided with three separate CPU's as claimed in claim 1, is very novel and not suggested by Stockdale '014. Stockdale simply did not recognize that yet a third level of hierarchical programing could lead to substantial improvements in processing efficiency in gaming machines.

Although there is known hierarchical structure in the programming field and use of higher level instructions and lower level instructions in Stockdale '014, the '014 instructions may be arranged in parallel. On the other hand, as Applicant's claim 1 reads, there are three distinct levels of hierarchical program, constructed in a series of control boards.

In the outstanding Office Action the Examiner at page 2 states as follows:

"Instead, Stockdale discloses all the inputs and outputs of the gaming machine may be controlled by a master gaming controller which sends out high level instructions to a peripheral controller which can use the high level instructions to send low level instruction precisely controlling the operation of its drive mechanism or pass the high level instructions to a second slot reel peripheral."

Applicant agrees that Stockdale teaches that the master gaming controller may send out high- or low-level instructions and that low-level instructions may also be initiated through a peripheral, such as peripheral controller (234) shown in '014.

The difference between Stockdale '014 and Applicant's claimed invention can best be seen by reference to Applicant's Figures 2 and 3. Figure 2 shows the location of subcontrol board (200) and image control board (300). As explained in Applicant's specification, the image control board consumes a substantial amount of computing power, and its complex housekeeping chores are best left to a separate image control CPU such as Applicant's CPU (301) shown in Figure 3. Applicant in Figure 3 shows the main control (100), which corresponds to Applicant's first hierarchical level, the intermediate control device (200), which has the second hierarchical level situated lower than the first hierarchical level, and a third or lower control device (300) which is lower than the second hierarchical level. Applicant respectfully submits that '014 simply does not show a first, second and most importantly the third hierarchical level. Still further, Applicant traverses the assertion that Stockdale teaches the transformation of high level signal by an intermediate device to a low level signal for use by a low level device (Office Action, page 3, lines 14 - 16).

The Examiner has cited Microsoft Press Computer Dictionary and a definition of structured programming. Structured programming is also defined as an early approach to programming

which emphasizes breaking large and complex tasks into successfully smaller sections, see Definition A attached. This is also referred to as structured programming (see attached Definition B). The dictionaries also define hierarchical computer networks as including lower-level computers (see attached Definition C). Next, the dictionary defines modular programming as "discrete and self-contained parts or modules used to break up large programs into smaller tasks, thus improving programming accuracy and production" (see attached Definition D).

All of the above definitions define what is well-known in the art of computer programming. Still further, the disclosure in '014 is nothing more and nothing less than that which is discussed in the prior art section of Applicant's own application, which describes prior art used in gaming machines.

The difference between Applicant's claimed invention of claim 1 and '014 is that '014 simply does not disclose any programming function at all in the peripherals that the Examiner claims are under control of the "low level". The low level is simply not subject to further processing and, therefore, is not part of a hierarchical programming scheme as those terms are used in the dictionary definitions attached hereto.

The Examiner argues at page 3, beginning at line 8 up from the bottom that Stockdale teaches transformation of a high-level signal by an intermediate device to a low-level signal for use by a low-level device. This simply is a signal, not a hierarchical programming as claimed.

The Examiner in reliance upon Microsoft 3rd edition, page 451 for a definition of structured programming has failed to show how Microsoft would suggest use of structured programming in the environment of the gaming machine of Stockdale. Stockdale standing alone certainly does not provide any suggestion of the use of structured programming, and in fact teaches directly away from it. Stockdale provides only low-level signals which cause specific lights to turn off, and specific actions at the peripheral devices. Simply stated, Stockdale never recognized that it would be useful or beneficial to have yet a further processing step at the peripheral level.

Claim 2

In the reference '014, as an example of devices to be controlled by the peripheral controller (234), the video display screen (34) is shown. Reading the description of '014, the video screen (34) is a screen itself, it is not considered that this screen is provided with such an individual CPU to control this screen and an individual ROM to store image data therein. That is, the video display screen (34) seems to be controlled by the peripheral controller (234), this is equivalent to the intermediate control device of the invention, and receives the image data from the peripheral controller (234). It is not disclosed in '014 that the video display screen (34) is controlled by a controller which is equivalent to the lower control device of the invention, and the image data is transmitted from the

controller equivalent to the lower control device of the invention. In addition, there is no description suggesting the above matter.

New Claim 10

New claim 10 is supported by Applicant's specification, page 36, line 24 through page 37, line 3. '014 at column 4, lines 14 and 15 states that the peripheral communicates with the master controller and Figures 2 and 3 show the two way communication. The sub-CPU 201 of the gaming machine in accordance with the present invention only transmits a signal to the image control board (300) in only one direction by way of an OUT port (205). The necessary image control CPU, the program ROM, etc. are mounted on this image control board (300) which is separate from those of sub-control board (200).

New Claim 11

Claim 11 is the same as original claim 2, except that it omits the functions of the main and lower control devices. The Remarks regarding claim 2 apply to claim 11.

In view of the foregoing, it is respectfully submitted that the application is now in condition for allowance, and early action in accordance thereof is requested. In the event there is any reason why the application cannot be allowed in this current condition, it is respectfully requested that the Examiner contact

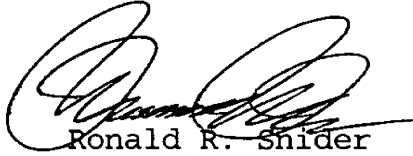
S/N: 09/740,064

7/23/2004

Docket No.: KAW-238-USAP

the undersigned at the number listed below to resolve any problems
by Interview or Examiner's Amendment.

Respectfully submitted,

A handwritten signature in black ink, appearing to read 'Ronald R. Snider', is written over the printed name.

Ronald R. Snider

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Date: July 23, 2004

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RRS/bam

crimson colour to flame and are used in fireworks. The radioactive isotope, ^{90}Sr , is produced in the fission of uranium and has a long life, hence its presence in 'fall-out' after a nuclear explosion.

strontium unit (*Phys.*). Used to measure the concentration of radioactive ^{90}Sr in calcium; $1\text{SU} = 10^{-12}\text{Ci g}^{-1}$.

strophole (*Bot.*). See *caruncle*.

strophism, strophic movement (*Bot.*). Growth movement in which an organ or its stalk twists in response to a directional stimulus e.g. the twisting of leaf bases and petioles on many horizontal branches in response to light and/or gravity resulting in the horizontal orientation of the leaf blades.

Strouhal number (*Acous.*). Factor in the equation for the frequency of an aeolian tone. The equation relates the frequency f with the speed v and the thickness d of the obstacle by $f = k.v/d$, where k is the Strouhal number.

Strowger exchange (*Telecomm.*). The rapidly-disappearing generation of telephone exchanges using entirely electro-mechanical switching; after Almon B. Strowger, their inventor.

struck (*Build.*). (1) Taken away, dismantled; said, e.g. of scaffolding or shuttering. (2) Joints on an exposed face of a wall are said to be *struck* when the mortar is recessed.

struck (*Vet.*). (1) A form of *enterotoxemia* of sheep caused by *Clostridium perfringens* (*Cl. welchii*), type C. (2) Said of sheep affected with blowfly myiasis.

struck core (*Foundry*). A loam core formed by revolving the built-up core, loam-covered, against a strikeboard.

struck-joint pointing (*Build.*). See *weathered pointing*.

structural (*Biol.*). Of changes, aberrations, etc. in the number or arrangement of chromosomes. But see *structural gene*.

structural colours (*Zool.*). Colour effects produced by some structural modification of the surface of the integument, as the iridescent colours of some Beetles. Cf. *pigmentary colours*.

structural damping (*Aero.*). See *damping*.

structural formula (*Chem.*). A representation of the chemical structure of a substance which shows not only its composition but also its connectivity and the order of the bonds connecting the atoms.

structural gene (*Biol.*). The stretch of DNA specifying the amino acid sequence of a polypeptide, as distinct from the interspersed and associated DNA, some of which is concerned with control of gene synthesis.

structural timber (*Build.*). (1) Canadian name for *carcassing timber*. (2) Any timber acting as a support.

structure (*Chem.*). See *molecular structure*.

structure (*Space*). Framework or ensemble of rigid elements which is designed to withstand a variety of mechanical and thermal influences (e.g. thrust forces, bending moments, aerodynamic heating effects) during launch and flight of a spacecraft and provide protective support for its subsystems and payload.

structure-borne sound (*Acous.*). Sound in solid bodies, as opposed to sound in gases (e.g. air-borne sound) and sound in liquids (e.g. water sound).

structured programming (*Comp.*). Orderly approach to programming which emphasizes breaking large and complex tasks into successively smaller sections. Also *top down programming*.

structure of the atom (*Chem.*). See *atomic structure*.

struma (*Med.*). (1) See *scrofula*. (2) See *goitre*.

strut (*Civ.Eng.*). A timber or adjustable metal member used for bracing purposes during excavation or construction works.

strut (*Eng.*). Any light structural member or long column which sustains an axial compressive load. Failure occurs by bending before the material reaches its ultimate compressive stress. See *column*.

Struthioniformes (*Zool.*). Any order of Birds retaining only two toes and whose feathers lack an aftershaft. They extend their rudimentary wings when running. Known from the Pliocene onwards. Ostriches.

strutting (*Build.*). The process of using props to give temporary support between two surfaces.

struvite (*Min.*). Magnesium ammonium phosphate hexa-

hydrate, crystallizing in the orthorhombic system. Found in guano and dung, and common in human calculi.

strychnine (*Chem.*). $\text{C}_{21}\text{H}_{22}\text{N}_2\text{O}_2$, a monoacidic alkaloid base, mp 265°C , very poisonous, causing tetanic spasms. It occurs in the seeds of *Strychnos ignatii* and *Strychnos nux vomica*, in *Upas tieutè* and in *Lignum colubrinum*. Strychnine is almost insoluble in water, but is readily soluble in chloroform and benzene.

strychnine bases (*Chem.*). A group of alkaloids obtained from *Strychnos nux vomica*. They include strychnine and brucine.

STS (*Space*). Abbrev. for *Space Transportation System*, usually refers to the Space Shuttle but actually includes *Spacelab*, inter-orbit stages carried by the Orbiter and the Tracking and Data Relay Satellite System (*TDRSS*), together with the supporting ground segment.

stub (*Build.*). A small projection on the under surface at the top edge of a tile, enabling it to be hung on a batten.

stub (*Telecomm.*). An auxiliary section of a waveguide or transmission line connected at some angle with the main section. See *coaxial*, *quarter-wavelength*.

stub antenna (*Telecomm.*). A quarter-wavelength rod or wire.

stub axle (*Autos.*). A short dead axle. If carrying a steered wheel it is capable of limited angular movement about a swivel-pin carried by the end of the axle beam.

stub plane (*Aero.*). A short length of wing projecting from the fuselage, or hull, of some types of aircraft to which the main planes are attached.

stub tenon (*Build.*). A very short tenon for fitting into a blind mortise. Also *joggle*.

stub-tooth gear (*Eng.*). A gear tooth of smaller height and of more robust form than that normally employed; used in the manufacture of automobile gears.

stub tuning (*Elec.Eng.*). Use of shunt stubs connected to short-circuited section of line or waveguide in order to produce matched conditions. In the single-stub tuner the stub susceptance is $-jb$ and it is connected to the main transmission line at a point where the transformed load admittance is $y = 1 + jb$ (normalized).

stuc (*Build.*). Plasterwork resembling stone.

stucco (*Build.*). A smooth-surfaced plaster or cement rendering applied to external walls.

stuck moulding (*Build.*). A moulding shaped out of the solid of a member.

stud (*Build.*). The vertical members in a timber partition framework.

stud (*Eng.*). A shank, or headless bolt, generally screwed from both ends and plain in the middle. It is permanently screwed into one piece, to which another is then secured by a nut.

student's t-test (*Stats.*). See *t-distribution*.

stud partition (*Build.*). A wooden partition based on rough vertical timbers.

stuff (*Build.*). (1) See *coarse stuff*, *fine stuff*. (2) Timber sawn or manufactured from logs.

stuffer box (*Textiles*). A box into which continuous filament yarn is packed closely so resulting in the yarn becoming crimped. The yarn may then be heated in order to set the crimp and produce a textured yarn.

stuffing-box (*Eng.*). A cylindrical recess provided in, for example, a cylinder cover, at the point at which the piston rod emerges; it is filled with packing which is compressed by a gland to make a pressure-tight joint.

stugging (*Build.*). See *picking*.

stuke (*Build.*). See *stucco*.

stupor (*Med.*). A state of mental and physical inertia: inhibition of instinctive activity and indifference to social environment.

sturdy (*Vet.*). See *coenuriaris*.

Sturm's theorem (*Maths.*). A theorem by which the number of real roots of an algebraic equation which lie in any given interval can be determined. It utilizes sign changes in the partial remainders that occur in calculating the HCF of $f(x)$ and $f'(x)$, where $f(x) = 0$ is the given equation.

Stuttgart disease (*Vet.*). Canine typhus. The name

Definition

(A)

mode (*Geol.*). The actual mineral composition of a rock expressed quantitatively in percentages. Cf. norm.

mode (*Phys.*). (1) One of several electromagnetic wave frequencies which a given oscillator may generate, or to which a given resonator may respond, e.g., magnetron modes, tuned line modes. In a waveguide, the mode gives the number of half-period field variations parallel to the transverse axes of the guide. Similarly, for a cavity resonator, the half-period variations parallel to all three axes must be specified. In all cases, different modes will be characterized by different field configurations. (2) Similarly, one of several frequencies of mechanical vibration which a body may execute or with which it may respond to a forcing signal. (3) A well-defined distribution of the radiation amplitude in a cavity which results in the corresponding distribution pattern in the laser output beam. In a multimodal system the beam will tend to diverge.

mode (*Space*). Situation or method of performing a specified task.

mode (*Stats.*). The most frequent value in a set of observations; the value of a random variable at which the corresponding probability density function is a maximum.

mode (*Telecomm.*). In optical fibres, the manner in which light rays travel inside the fibre. There are a variety of paths because the light can be reflected internally at a variety of angles. See monomode fibre, multimode fibre.

mode dispersion (*Telecomm.*). In optical fibre communications, distortion or smearing of individual pulsed components of digital signals, caused by the different modes of propagation of the light inside the fibre arriving at the receiver at different times. Pulses need to be detected and re-generated before this leads to distortion and/or errors.

mode jump (*Telecomm.*). Switch of a magnetron or similar microwave generator from one mode to another; also mode shift.

modelling (*Behav.*). In behaviour therapy, the learning of a new behaviour by imitation of a model, and usually overtly or covertly reinforcing the desired behaviour.

mode-locking (*Phys.*). A technique for producing laser pulses of extremely short duration. Laser cavities have modes with frequency spacing $c/2L$ where c is the speed of light and L is the length of the cavity. Oscillations can occur in any mode as long as its frequency is within the natural line width of the laser transition. If a property of the cavity is modulated at a frequency of $c/2L$, then all the modes become coherently coupled. A train of extremely short pulses is emitted where the time duration is roughly the inverse of the line width. See laser.

modem (*Comp. Telecomm.*). Device which converts between digital bits and analogue electrical impulses which can be transmitted as a frequency modulated tone over telephone circuits. *MODulator/DEMulator*.

mode number(s) (*Electronics*). These indicate the mode in which devices capable of operating with more than one field configuration are actually being used, e.g. in a cavity resonator, the mode numbers indicate the number of half wavelengths in the field pattern parallel to the three axes; in a magnetron, the mode number gives the number of cycles through which the phase shifts in one circuit of the anode; and in a klystron, it gives the number of cycles of the field which occur while an electron is in the field-free drift space.

moder (*Bot.*). Form of humus intermediate between mull and mor.

moderation (*Nuc. Eng.*). The slowing down of neutrons in a reactor to thermal energies.

moderation (*Phys.*). See degradation.

moderator (*Nuc. Eng.*). Material such as water, heavy water, graphite used to slow down neutrons in a reactor. See lethargy of neutrons.

moderator control (*Nuc. Eng.*). Control of a reactor by varying the position or quantity of the moderator.

modern face (*Print.*). A style of type with contrasting thick and thin strokes, serifs at right angles, curves thickened etc. See type.

mode separation (*Telecomm.*). The frequency difference between operation of a microwave tube in adjacent modes. See mode jump.

mode shift (*Telecomm.*). See mode jump.

modified refractive index (*Meteor.*). Sum of the refractive index of the atmosphere at a given height and the ratio of the height to the radius of the earth.

modifier (*Biol.*). A gene which influences the effect of another.

modifier (*Comp.*). A code element used to alter the address of an operand. See address calculation.

modifier (*Min. Ext.*). Modifying agent used in froth flotation to increase either the wettability or the water-repelling quality of one or more of the minerals being treated.

modiolus (*Zool.*). The conical central pillar of the cochlea.

modular (*Electronics*). Form of construction in which units, often with differing functions, are therefore quickly interchangeable.

modular design (*Arch.*). A design on a grid of fixed dimensions, generally to facilitate the prefabricated manufacture of building components.

modular programming (*Comp.*). An approach to programming in which separate logical tasks are programmed separately and joined later. See structured programming, segmentation.

modular ratio (*Civ. Eng.*). The ratio between Young's modulus for steel and that for the concrete in any given case of reinforced concrete.

modulated amplifier (*Telecomm.*). An amplifier stage during which modulation of the signal is carried out. Also *modulated stage*.

modulated carrier, wave (*Telecomm.*). A frequency which can be transmitted or received through space or a transmission circuit, with a superposed information signal, which, by itself, could not be effectively transmitted and received.

modulated continuous wave (*Telecomm.*). Transmission in which a carrier is modulated by a tone and interrupted by keying. Abbrev. *MCW*.

modulated stage (*Telecomm.*). See modulated amplifier.

modulating electrode (*Electronics*). That of a thermionic valve to which a voltage is applied to control the size of the beam current.

modulation (*Acous.*). (1) Change of amplitude or frequency of a carrier signal of given frequency. (2) Changing from one key to another in music. The continual change from one fundamental frequency to another in speech.

modulation (*Telecomm.*). The process of impressing information (code, speech, video, data etc.) onto a higher frequency carrier. See frequency modulation, delta modulation, phase modulation, frequency-shift transmission, dual modulation, pulse code-, pulse width- and pulse-amplitude modulation.

modulation capability (*Telecomm.*). The maximum percentage modulation which can be used without exceeding a specified distortion level.

modulation condition (*Telecomm.*). The condition of voltages and currents in an amplifier for a modulated signal when the carrier is steadily modulated to a stated degree, e.g. 100%.

modulation depth (*Telecomm.*). Factor indicating extent of amplitude modulation of a carrier. *Difference* = sum of peak and trough values of a modulated wave. Often expressed as a percentage.

modulation distortion (*Telecomm.*). Any distortion in the transmission of a signal introduced during the process of modulating that signal onto the carrier.

modulation frequency (*Telecomm.*). One impressed upon a carrier wave in a modulator.

modulation index (*Telecomm.*). In a frequency modulation system and in the case of a simple sinusoidal modulation signal, the ratio of the frequency deviation to the frequency of the modulating signal.

modulation pattern (*Telecomm.*). That on an oscilloscope when the amplitude-modulated wave is connected to the

Y-deflection
deflecting
enables
modulation
shortest
instantaneous
seconds
modulation
the modulation
transmission
modulation
change
modulation
a radio
at low
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emana
pass. I
mogas
octane
modulation
goat
Mohr b
by wei
Mohr-C
to cru
bondi
Mohr's
(NH₄)

DEFINITION B

hidden variables *Quantum Mechanics*. the postulated unobservable parameters possessed by a system that are inaccessible to measurement and that determine the values of individual measurable quantities of the system (such as position, momentum, and spin) not specified by its wave function, and, according to standard quantum theory, not yet determined in any sense.

hidden-variables theory of the first kind *Quantum Mechanics*. a theory based on the existence of hidden variables, in which a system's hidden variables decay quickly to an equilibrium distribution, whereupon the system will behave exactly as predicted by standard quantum theory.

hidden-variables theory of the second kind *Quantum Mechanics*. a theory in which the outcome of any conceivable experiment on a system is predetermined according to its hidden variables; such a theory fundamentally contradicts standard quantum theory, and predicts certain experimental results that differ from those predicted by quantum theory.

hide *Materials*. a raw or dressed animal skin, especially that of a relatively large animal.

hidebound *Botany*. of trees, having the bark so close and tight that it impedes growth.

hidr- or hidro- a combining form meaning "sweat," as in *hidradenoid*, *hidrosis*.

hidradenitis *Medicine*. an inflammation of a sweat gland.

hidradenoma see *SPIRADENOMA*.

hidradenoma papilliferum *Medicine*. an uncommon tumor derived from the epithelial cells of sweat glands, usually occurring in the labia majora.

hidrosis [hī drō'sis] *Medicine*. the production and secretion of sweat. Thus, *hidrotic*.

hiemal climate *Meteorology*. a winter climate.

hierarchical [hī'ər är'ki kəl] *Behavior*. describing a social group that has a hierarchy. *Computer Science*. relating to or arranged in a ranked or graded series. Thus, hierarchical database, hierarchical file, hierarchical storage management.

hierarchical computer network *Computer Technology*. a form of distributed processing system having two or more levels, in which a central computer controls and distributes various functions to lower-level computers which may, in turn, further distribute work to the next lower level; the lower the level in the structure, the more narrow the responsibilities. Also, hierarchical-distributed processing system.

hierarchical control *Robotics*. a type of distributed control where robotic processes are arranged in a hierarchy, with those above sending control signals to those below, and the ones below sending feedback and sensor signals to those above. Also, *CONTROL HIERARCHY*.

hierarchical memory *Computer Technology*. a computer architecture incorporating multiple kinds of memory, with the fastest and most expensive memory such as cache memory at the top of the hierarchy and slower, more voluminous, and less expensive memory at lower levels.

hierarchical planning *Artificial Intelligence*. a form of planning in which a task is decomposed into subtasks, which are likewise decomposed, until primitive actions are reached.

hierarchical semantic network *Artificial Intelligence*. a pictorial knowledge-representation technique in which objects and their relationships are grouped into sets that are relevant to the goal; nodes represent concepts or objects, and arcs represent relationships.

hierarchy [hī'ər är'kē] *Behavior*. a social system within a group of animals of the same species, in which individuals exercise dominance over those ranking lower in status and are in turn dominated by those ranking higher.

hierarchy of (human) needs *Psychology*. Abraham Maslow's classification of human needs and motives, ascending in a pyramid from the basic level of physiological needs, such as hunger and thirst, to the highest level of self-actualization.

hiemalite *Mineralogy*. K_2SiF_6 , a colorless to grayish, cubic mineral having a specific gravity of 2.665 and a hardness of about 2.5 on the Mohs scale; found as stalactitic concretions in fumarolic deposits.

hieroglyph *Archaeology*. a single character or pictorial element used in hieroglyphics. *Geology*. any sedimentary structure or mark found on a bedding plane.

hieroglyphic [hī'rō glif'ik] *Archaeology*. of or relating to a system of writing using hieroglyphics.

hieroglyphics [hī'rō glif'iks] *Archaeology*. a writing system, especially the one used by the ancient Egyptians, in which meaning is expressed by standardized pictorial symbols that represent the objects and ideas being described.

hierophobia *Psychology*. an irrational fear of heights. Also, *HAGIOPHOBIA*.

hi-fi *Acoustics*. a shorter term for equipment.

Higgins larva *Invertebrate Zoology*. a larval stage of a ciliate that is close to the adult form, with stylets and the thorax lacks spines.

Higgs bosons *Particle Physics*. particles that result when spontaneous symmetry breaking occurs.

Higgs mechanism *Particle Physics*. the weak force that gives mass to the Higgs bosons.

high *Meteorology*. a high-pressure weather system with a relative rotational velocity. Also, *HIGH-PRESSURE SYSTEM*.

high airburst *Ordnance*. the fall of a weapon that increases damage or contamination at ground zero.

high-alloy steel *Metallurgy*. any of a group of steels in which the amount of alloying elements besides iron exceeds 1.65% and copper and silicon are present.

high aloft see *UPPER-LEVEL ANTICYCLONE*.

high-altitude burst *Ordnance*. the fall of a weapon at an altitude over 100,000 feet.

high-altitude method *Navigation*. a method of determining position using the geographic line of position using the geographic distance as the center and the zenith distance as the radius.

high-altitude sickness see *ALTITUDE SICKNESS*.

high-altitude station *Meteorology*. a station established at an elevation of at least 10,000 feet.

high-angle fault *Geology*. a fault having a steep dip.

high-angle fire *Military Science*. fire directed at a target from a position higher than the elevation that will produce the maximum effect.

high-angle gun *Ordnance*. a gun, usually capable of firing at a high elevation.

high-angle strafe *Military Science*. high-angle dive, usually 45° or greater.

high anticyclone see *UPPER-LEVEL ANTICYCLONE*.

high band *Telecommunications*. the frequency band from 174 to 216 MHz; the high frequency band.

high blood pressure *Medicine*. the condition in which the blood pressure is abnormally high.

high blower *Aviation*. a blower-type engine.

high boost see *HIGH-FREQUENCY COMBINATION*.

high-burst ranging *Ordnance*. the process of determining the range of a serving airburst.

high burst *Ordnance*. a high-altitude burst.

high burst *Ordnance*. a high-altitude burst.

high burst *Ordnance*. a high-altitude burst.

high burst *Ordnance*. a high-altitude burst.

high burst *Ordnance*. a high-altitude burst.

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high burst *Ordnance*. a high-altitude burst.

high burst *Ordnance*. a high-altitude burst.

high burst *Ordnance*. a high-altitude burst.

high burst *Ordnance*. a high-altitude burst.

hieroglyph

DEFINITION 6

mode transducer *Electronics*. a device that is designed to transform an electromagnetic wave from one mode of propagation to another. Also, **mode transformer**.

modifier gene *Genetics*. a gene that changes or augments the phenotypic expression of a nonallelic gene.

modifiability *Mechanical Devices*. the ability of a machine or device to be modified after it has been produced. *Robotics*. specifically, the ability to change or alter a robot's program.

modification *Engineering*. a temporary or permanent change made to an object or process in order to improve design or performance, or to correct a defect. *Behavior*. see BEHAVIOR MODIFICATION.

modification enzymes *Enzymology*. bacterial enzymes (methylases) that attach methyl groups at special sites on the bacterial DNA, thereby protecting it from digestion by indigenous endonucleases that digest foreign DNA injected into the cell by a bacteriophage.

modification kit *Engineering*. a group of tools or components used to modify the performance or design of an object or process.

modified Bessel functions *Mathematics*. Bessel functions of imaginary argument. A commonly used form is given by

$$K_n(x) = i^{-n} J_n(ix),$$

where J_n is the Bessel function of order n and x is positive and real.

modified constant-voltage charge *Electricity*. a method of charging a storage battery in which voltage of the charging current remains constant over a fixed resistance inserted into the battery circuit; a high-voltage characteristic occurs at the battery terminals as the charge increases.

modified gunmetal *Metallurgy*. a form of gunmetal that contains 2.5% lead.

modified Hankel functions *Mathematics*. Hankel functions of imaginary argument. A commonly used form is given by

$$K_n(x) = \pi i/2 (i)^n H_n^{(1)}(ix),$$

where $H_n^{(1)}$ is the first Hankel function of order n and x is positive and real; sometimes included in the definition of modified Bessel functions. Also, MACDONALD FUNCTIONS.

modified index of refraction *Meteorology*. the sum of the refractive index of the atmosphere at a given height and the ratio of the height to the radius of the earth.

modified Lambert conformal chart *Cartography*. a chart based on the modified Lambert conformal map projection. Also, NEY'S CHART.

modified Lambert conformal map projection *Cartography*. the Lambert conformal map projection as modified for use in polar maps and charts, with two standard parallels, and with all parallels forming complete concentric circles. Also, NEY'S MAP PROJECTION.

modified Lewis acid *Physical Chemistry*. an acid that accepts halide ions.

modified polyconic map projection *Cartography*. the regular polyconic projection modified so that the scale is exact along two standard meridians, equidistant from the central meridian, rather than along only one. Also, RECTANGULAR POLYCONIC MAP PROJECTION.

modified radical mastectomy *Medicine*. the surgical removal of the entire breast including nipple, areola, overlying skin, and axillary lymph nodes.

modifier something that changes or alters; specific uses include: *Computer Programming*. a quantity that is used to modify the address of an operand in an instruction; for example, the cycle index in a loop sequence. *Materials Science*. an oxide that, when added to a glass, disrupts the glassy network, eventually causing crystallization.

modifier gene *Genetics*. a gene that changes or augments the phenotypic expression of a nonallelic gene.

modify to change the form or effect of something; specific uses include: *Computer Programming*. 1. to alter an instruction in a way that changes its interpretation and execution, either temporarily or permanently. 2. to alter a program according to a given parameter.

modillion *Architecture*. an embellished bracket used in series to support the corona under a cornice, especially of the Corinthian order.

moding *Electronics*. a fault in magnetron oscillation in which it oscillates in an undesired mode or modes.

modioliform *Paleontology*. having the shape that is distinctive of the genus *Modiolus*.

Modiolus *Paleontology*. a still-extant genus of pteriomorphic bivalves in the subclass Isofilibranchia and order Mytiloida; *Modiolus* is generally a burrower but in the past may have also sometimes attached itself byssally to seaweed. It has a distinctive shape, which is also found in a few other genera.

modiolus *Anatomy*. the central post around which the spiral turns of the cochlea are formed.

Mod. praesc. *Medicine*. in the way directed. (From Latin *modus praescipio*.)

Modula *Robotics*. a modular programming language similar to that that can be used to program a robot.

Modula-2 *Computer Programming*. a high-level programming language developed for systems programming that supports modularity and contains constructs for parallel programming; derived from Pascal.

modular *Science*. composed of standardized units or sections. *Robotics*. relating to or designating a robotic system composed of units with interchangeable parts that can be combined in various ways to perform a wide variety of tasks.

modular arithmetic *Mathematics*. in elementary number theory, addition and multiplication of residue classes. Intuitively, this is accomplished by forming the sum or product in the usual way, dividing the result by a fixed positive integer m (the modulus), and using the remainder as the answer to the computation. Identical results are obtained by using representatives of the congruence classes (mod m). In this text, congruence classes are also referred to as residue classes. The integers (mod m) form a commutative ring with unit element. If m is prime, then the integers (mod m) form a field. Also, ARITHMETIC MODULO m , ARITHMETIC MOD m .

modular circuit *Electronics*. a circuit designed and built as separate modules that are connected to perform the function.

modular compilation *Computer Programming*. the translation of portions of a program into machine language, followed by link editing as opposed to translation of the complete program.

modular design *Robotics*. a system design that uses standardized software and hardware products.

modular form *Mathematics*. 1. an analytic function $F(z_1, z_2)$ of two complex variables defined for $\text{Im}(z_1/z_2) > 0$ such that: (a)

$$F(\lambda z_1, \lambda z_2) = \lambda^r F(z_1, z_2),$$

where λ is any constant (i.e., homogeneity of degree r); and (b)

$$F(dz_1 + cz_2, bz_1 + az_2) = F(z_1, z_2),$$

where a, b, c , and d are any constants such that $ad - bc = 1$. 2. alternatively, a meromorphic function $F(\tau)$ defined for $\text{Im} \tau > 0$ is called a modular form of degree r if it satisfies

$$F((a\tau + b)/(c\tau + d)) = (c\tau + d)^{-r} F(\tau),$$

where a, b, c , and d are any constants such that $ad - bc = 1$. A modular form of degree 0 is a modular function or automorphic function.

modularity *Computer Programming*. the property of a program that is composed of a collection of well-defined, logically self-contained segments or subroutines.

modular programming *Computer Programming*. the design of a program as a set of logically discrete and self-contained parts or modules used to break up large programs into smaller tasks, thus improving programming accuracy and production. Also, STRUCTURED PROGRAMMING.

modular robot *Robotics*. a nonservo robot that has seven axes; used for parts transfer, machine loading and unloading, and pressworking.

modular structure *Electronics*. 1. an assembly using integral multiples of a given length to form electronics components. 2. an assembly created from modules.

modulate *Electronics*. to change in some characteristic way the amplitude, frequency, or phase of a wave or the velocity of the electrons in an electron beam.

modulated amplifier *Electronics*. the amplifier stage in a transmitter in which the modulating signal is introduced and modulates the carrier.

modulated carrier *Telecommunications*. a radio-frequency carrier in which the frequency or amplitude has been varied by, and in accordance with, the conveyed intelligence.

modulated continuous wave *Telecommunications*. a wave in which the carrier is modulated by a steady audio-frequency tone.

modulated Raman scattering *Spectroscopy*. a spectroscopic technique in which wavelength variation and externally applied perturbations are used to lower symmetry in order to analyze the light scattered by certain crystals.

modulated stage *Electronics*. the radio-frequency stage to which the modulator is coupled, in which the carrier wave is modulated in accordance with the system of modulation and the characteristics of the modulating wave.

DEFINITION